

## Topical Lidocaine Adrenaline Tetracaine (LAT Gel) Versus Injectable Buffered Lidocaine for Local Anesthesia in Laceration Repair

AMY A. ERNST, MD, FACEP, *Nashville, Tennessee*; EDUARDO MARVEZ-VALLS, MD, FACEP, *New Orleans, Louisiana*; TODD G. NICK, PHD, *Jackson, Mississippi*; and TREVOR MILLS, MD, LUCIA MINVIELLE, NP, and DEBRA HOURY, *New Orleans, Louisiana*

The objective of the study was to compare topical lidocaine adrenaline tetracaine (LAT gel) with injectable buffered lidocaine with epinephrine regarding pain of application or injection and anesthesia effectiveness. The study was a randomized prospective comparison trial in an urban emergency department. Physicians and patients ranked the pain of application, injection, and suturing according to a 10-cm visual analog scale. Sixty-six patients were entered, 33 in the LAT gel group and 33 in the injectable buffered lidocaine group. Injection was found to be significantly more painful than application of gel ( $P < 0.001$ ). For anesthesia effectiveness, there was no difference according to patients ( $P = 0.48$ ) or physicians ( $P = 0.83$ ) for topical vs injectable forms. The number of sutures causing pain was not statistically different in the two groups ( $P = 0.28$ ). In conclusion, LAT gel compared favorably with injectable buffered lidocaine for local anesthesia effectiveness and was significantly less painful to apply. It may be the preferred local anesthetic for this reason.

(Ernst AA, Marvez-Valls E, Nick TG, Mills T, Minvielle L, Houry D. Topical lidocaine adrenaline tetracaine (LAT gel) versus injectable buffered lidocaine for local anesthesia in laceration repair. *West J Med* 1997 August; 167:79–81)

Anesthetics are known to be painful to inject.<sup>1,2</sup> Buffered solutions that adjust the pH of commercially available anesthetic solutions have been shown to decrease the pain of infiltration.<sup>3,4</sup> In a previous comparison trial of four injectable anesthetics, lidocaine with epinephrine was found to be more effective for anesthesia than that without epinephrine.<sup>5</sup> Topical lidocaine adrenaline tetracaine (LAT gel) has been compared with tetracaine adrenaline cocaine and found to be effective in children with lacerations of the face and scalp,<sup>6</sup> and a liquid form of topical LAT was found to be effective in adults compared with tetracaine adrenaline cocaine.<sup>7</sup>

### Methods

This study, which was prospective and randomized, was approved by the institutional review board. The primary endpoints were patient and physician perception of application or injection pain and anesthesia effectiveness.

The study was performed in an urban emergency department. A convenience sampling of patients who had simple lacerations were entered in the study.

Patients were eligible if they were age 5 years or older with simple linear lacerations 1.5–10 cm long. Patients were excluded if they were allergic to amides or esters; if there was suspected alcohol or drug use, altered mental status, pregnancy, or glaucoma; if they did not wish to participate in the study; if the location of the laceration involved possible vascular compromise; or if the wound was more than 8 hours old.

The topical solutions (LAT gel) were prepared in December 1995 by a pharmacist. The injectable solutions (buffered lidocaine with epinephrine) were prepared one or two at a time by one of the authors of the study. All solutions were stored at room temperature, the gels in 5-cc syringes with stoppers and the injections in 10-cc syringes. The doses of anesthetic were numbered 1–66 according to a computer-generated random table of numbers prepared before the study. The injectable buffered lidocaine solutions were prepared by mixing 1 cc of 8.4%  $\text{NaHCO}_3$  with 9 cc commercially prepared 1% lidocaine with epinephrine. The total volume available was 10 cc. The topical gel was prepared as 4% lidocaine, 1:2000 epinephrine, and 0.5% tetracaine in a gel form (hydrox-

From the Department of Emergency Medicine, Vanderbilt University (Dr Ernst); Section of Emergency Medicine, Louisiana State University (Drs Marvez-Valls, Mills, and Minvielle); University of Mississippi (Dr Nick); and Tulane University School of Medicine (Dr Houry).

Reprint requests to Amy A. Ernst, MD, FACEP, Vanderbilt University, Department of Emergency Medicine, 703 Oxford House, Nashville, TN 37232-4700.

**ABBREVIATIONS USED IN TEXT**

LAT = lidocaine adrenaline tetracaine

yethyl cellulose) with preservatives. The gel was prepared by a pharmacist from dried ingredients mixed with water and added to the hydroxyethyl cellulose gel. The total volume of each gel was 3 cc. Because of the obvious differences in form and application, physicians and patients were not blinded to the form of anesthesia.

All personnel performing suturing were oriented to the protocol of slow infiltration with a 25-gauge needle. LAT gel was applied with a cotton swab in and up to 1 cm around the wound edge, and the gel was left in place for 10 minutes. If the patient was still sensitive to pinprick after 10 minutes, the gel remained another 10 minutes. If the patient was still sensitive, 1% lidocaine was added. The pain of application was determined after anesthetic was applied or injected and before suturing began.

Laceration repair was performed by one of the study authors, resident physicians, or nurse practitioners oriented to the study protocol. The length of the laceration, location, length of time anesthesia lasted, amount of anesthesia used, necessity for additional lidocaine, and treatment success or failure were recorded at the time of the procedure, along with any complications.

Patients and physicians ranked the pain of injection or application and the pain of suturing (anesthesia effectiveness) using a previously validated linear visual analog scale<sup>8</sup> so that each laceration had four associated measurements of pain. Each visual analog scale was a horizontal line graph 10 cm long with the words "no pain" at the left end and "worst pain" at the right end. Thus a score of 10.0 cm represented the most severe pain. The scale was shown to the patient before starting the procedure to familiarize the patient with the study protocol and use of the scale. Patients were followed by telephone, return visits to the emergency department, and medical records.

The a priori analysis determined that 66 patients were needed to have a power of 0.9 to detect a 1.2-cm difference in visual analog scale readings.

**Results**

The data were analyzed after 66 subjects were entered in the study, including 13 children ages 5 to 17. Thirty-three subjects received LAT gel and 33 received injectable buffered lidocaine with epinephrine. The number requiring further anesthesia was two in the LAT gel group and none in the injectable group (too few to apply statistical analysis). In one of the two needing further anesthesia, the gel was not allowed to remain in place after 10 minutes of application as per protocol, and the scores for this entry were excluded from the calculations.

There were differences between the LAT gel and injectable buffered lidocaine groups in two areas of demographics, sex and amount of local anesthesia used. There were statistically fewer females in the LAT gel

Table 1.—Demographics

	LAT Gel	Injectable Lidocaine	P Value
Sex (M/F) . . . . .	5/28	13/20	0.027*
Age (years) . . . . .	29	30	0.36*
Length of laceration (cm) . . . . .	2.3	2.5	0.87*
Initial amount of local anesthesia (cc) . . . . .	1.7	4.6	0.06*
Need for more anesthesia (n) . . . . .	2	0	
Location of laceration (n)			
Extremity . . . . .	13	11	0.23†
Face . . . . .	17	13	
Scalp . . . . .	3	7	

Results are means.

\*Wilcoxon rank sum test.

† $\chi^2$  test, extremities vs face and scalp.

group ( $P = 0.027$ ). More volume of solution was used in the injectable buffered lidocaine group ( $P < 0.001$ ). Mean age, length of lacerations, and location of lacerations were approximately equally divided for the LAT gel vs injectable buffered lidocaine group. These results are summarized in Table 1.

Topical lidocaine application was significantly less painful than injection of lidocaine according to both patients and physicians ( $P < 0.001$ ) (Table 2). For suturing (anesthesia effectiveness), patients and physicians found no difference between LAT gel and injectable buffered lidocaine ( $P = 0.83$  physicians and  $P = 0.48$  patients) (Table 3). The number of sutures causing pain according to patients, another measure of anesthesia effectiveness, was calculated as a percent (Table 4). There was no difference in LAT gel vs injectable buffered lidocaine in the percent of sutures causing pain ( $P = 0.28$ ).

Because of the difference in numbers of females between the two groups, we compared measures for males vs females. Using  $\chi^2$  analysis, we found no differences in demographics ( $P > 0.05$ ). For physician and patient pain scores during suturing, sex and treatment group were not significantly different for the topical vs injectable group. There was a difference in males vs females with injection pain according to physicians, with females having greater pain than males ( $P = 0.015$ ).

Table 2.—Physician and Patient Rating of Pain of Local and Topical Anesthetic Application (Visual Analog Score)

	LAT Gel	Injectable Lidocaine	P Value
Median (interquartile range)			
Physician rating . . . . .	0 (0–0)	1.4 (0.45–3.45)	0.001
Patient rating . . . . .	0 (0–0.15)	1.2 (0.15–2.75)	0.001

P values were determined using Wilcoxon rank sum test.

Table 3.—Physician and Patient Rating of Pain of Suturing (Visual Analog Score)

	LAT Gel	Injectable Lidocaine	P Value
Median (interquartile range)			
Physician rating . . . . .	0 (0–0.55)	0 (0–0.35)	0.83
Patient rating . . . . .	0 (0–1.35)	0 (0–0.6)	0.48

P values were determined using Wilcoxon rank sum test.

The mean score for injections for males was 1.4, and for females, 2.8. For females, LAT gel was significantly less painful to apply than buffered lidocaine was to inject. The mean scores for application for LAT gel for females was 0, and for males, 0.3.

To determine effectiveness of LAT gel vs injectable buffered lidocaine at extremity locations, a comparison was made for laceration scores at extremity locations vs face and scalp. Using Wilcoxon's rank sum test, we detected no difference in physician application ( $P = 0.49$ ), patient application ( $P = 0.87$ ), or physician suturing ( $P = 0.17$ ) for extremity lacerations in the two groups. For patient suturing, the difference for extremities (median score 1.2; mean score 2.4) vs face and scalp (median score 0; mean score 0.3) was nearly significant ( $P = 0.052$ ).

Follow-up was available in 75% of the patients, with equal rates in the topical and injectable groups. No complications or wound infections were reported.

## Discussion

In previous studies of topical anesthetics, there is no mention of pain or discomfort of application.<sup>6,7,9–12</sup> In this study, we compared an injectable anesthetic with LAT gel to determine differences in application or injection pain and to determine if LAT gel was as effective an anesthetic as an injection. Previous studies have compared topical LAT to tetracaine adrenaline cocaine,<sup>6,7,12</sup> but comparison has never been made to injectable anesthetics. We chose injectable buffered lidocaine with epinephrine because we have found that solutions with epinephrine are preferred for anesthesia effectiveness. We speculate that this is because vasoconstrictor action keeps anesthesia localized to the wound site.<sup>5</sup> Our power was 0.9 to detect a 1.2-cm difference in readings of a visual analog scale. This difference is consistent with the minimum clinically significant difference according to a previous study.<sup>13</sup>

We detected a difference in application or injection pain, with LAT gel being significantly less painful to apply. Patients and physicians preferred LAT gel for this reason. This factor may be especially important in children, in whom ease of laceration repair depends on

Table 4.—Percent of Sutures Causing Pain, per Patient

	LAT Gel	Injectable Lidocaine	P Value
Mean (%) . . . . .	13	6	0.28
Median (interquartile range) . . .	0 (0–18)	0 (0–0)	

P values were determined using Wilcoxon rank sum test.

cooperation. Other uses are in lacerations requiring plastic repair—topical anesthetics do not distort tissues during repair. Another advantage is less needle exposure for health care personnel.

There were significantly fewer females in the LAT gel group. With further analysis of the results of the study, no difference in pain scores was found, except application pain according to physicians for male vs female patients. Whether there is a difference in perceived pain from laceration repair in females vs males is unknown.

The difference in anesthetic effectiveness in extremities vs the face and scalp approached statistical significance. Previous studies have shown that topicals are less effective at extremity sites, perhaps because of less vascularity than the face and scalp.<sup>10,11</sup> Further study of the use of LAT gel in extremities is needed.

## REFERENCES

1. Wightman MA, Vaughan RW. Comparison of compounds used for intradermal anesthesia. *Anesthesia* 1976; 45:687–689
2. Morris R, McKay W, Mushlin P. Comparison of pain associated with intradermal and subcutaneous infiltration with various local anesthetic solutions. *Anesth Analg* 1987; 66:1180–1182
3. McKay W, Morris R, Mushlin P. Sodium bicarbonate attenuates pain on skin infiltration with lidocaine, with or without epinephrine. *Anesth Analg* 1987; 66:572–574
4. Christoph RA, Buchanan L, Begalia K, Schwartz S. Pain reduction in local anesthetic administration through pH buffering. *Ann Emerg Med* 1988; 17:117–120
5. Ernst AA, Marvez-Valls E, Nick TG, Wahle M. Comparison trial of four injectable anesthetics for laceration repair. *Acad Emerg Med* 1996; 3:228–233
6. Ernst AA, Marvez E, Nick TG, Chin E, Wood E, Gonzaba WT. Lidocaine adrenaline tetracaine gel versus tetracaine adrenaline cocaine gel for topical anesthesia in linear scalp and facial lacerations in children aged 5 to 17 years. *Pediatrics* 1995; 95:255–258
7. Ernst AA, Marvez-Valls E, Nick TG, Weiss SJ. LAT versus TAC for topical anesthesia in face and scalp lacerations. *Am J Emerg Med* 1995; 13:151–154
8. Scott J, Huskisson EC. Graphic representation of pain. *Pain* 1976; 2:175–184
9. Pryor GJ, Kilpatrick WR, Opp DR. Local anesthesia in minor lacerations: topical TAC versus lidocaine infiltration. *Ann Emerg Med* 1990; 9:568–571
10. Hegenbarth MA, Altieri MF, Hawk WH, Greine A, Ochsenschlager D, O'Donnell R. Comparison of topical tetracaine adrenaline and cocaine anesthesia with lidocaine infiltration for repair of lacerations in children. *Ann Emerg Med* 1990; 19:63–67
11. Bonadio WA, Wagner V. Efficacy of TAC topical anesthetic for repair of pediatric lacerations. *AJDC* 1988; 142:203–205
12. Schilling CG, Bank DE, Borchert BA, Klatzko MD, Uden DL. Tetracaine, epinephrine and cocaine (TAC) versus lidocaine epinephrine, and tetracaine (LET) for anesthesia of lacerations in children. *Ann Emerg Med* 1995; 25:203–208
13. Todd KH, Funk JP. The minimum clinically important difference in physician-assigned visual analog pain scores. *Acad Emerg Med* 1996; 3:142–146